

**Monograph of the earlier stages of the ODONATA.**

Sub-families GOMPHINA and CORDULEGASTRINA.

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Mr. Louis Cabot has published in the "Memoirs of the Museum of Comparative Zoölogy" the immature state of the Gomphina 1872 (ready for publication 1871) and of the Aeschnina 1881 (ready for publication 1873). As there is no hope of seeing the four other parts published by him, and as the collection has received additions so numerous as to justify a new publication, the first part containing the two sub-families Gomphina and Cordulegastrina (the latter was considered formerly as belonging to the Gomphina) will commence the series. Of the seventeen species described by Mr. Louis Cabot, only four were raised. The material is now three times as large; of the forty-eight described species sixteen are raised. The determination of the species is made according to the "Monographie des Gomphines par Edm. De Selys Longchamps," and the four additions to the Synopsis des Gomphines by the same author. These works contain the descriptions of 240 species. This paper was ready for publication April, 1884. The help given to my work by other entomologists is thankfully acknowledged with each species.

## SYNOPSIS.

Tarsi with 2-2-3 joints.....Legio GOMPHUS and GOMPHOIDES.  
 Tarsi with 2-2-2 joints.....Legio LINDENIA.  
 Tarsi with 3-3-3 joints.....Sub-family **CORDULEGASTRINA.**

Hind legs more distant at base than the others.....Legio GOMPHUS and GOMPHOIDES.

Palpus not dentated, without terminal hook..HERPETO- and OPHIOGOMPHUS.  
 Palpus dentated, with terminal hook.....**GOMPHUS.**

(The first two genera have the middle third of the front margin of the mask produced in a rounded lobe: the others not: for some exceptions the text is to be compared.)

Middle legs less distant than forelegs; abdomen prismatic... **Progomphus.**

Middle legs and forelegs equally distant; apical third or more of the abdomen formed by the thin cylindrical tenth segment.....**Gomphoides.**

Middle legs more distant than forelegs; abdomen flat, circular.....**Hagenius.**

## Sub-family—GOMPHINA.

## I LEGIO GOMPHUS.

Genus **GOMPHUS**.

Selys Monogr. Gomphin. p. 12.

This genus represents alone the Legio Gomphus. Selys.

The known nymphæ of the great genus Gomphus are homogeneous in the following characters :

1. The hind legs are more distant at the base than the fore- and middle legs, which are equally distant, and fitted for burrowing by a strong external hook (rarely less developed or wanting) on tip of tibia, and often also an internal hook on tip of femur ; the four anterior tarsi are 2-jointed, the posterior ones 3-jointed.

2. The head is depressed, more or less flattened ; the antennæ are short, 4-jointed ; the two basal joints short, annular, the third longer than both together, stout, the fourth rudimentary and very small ; the eyes large, globular ; in transformation the skin splits through the middle of the eyes ; the large labrum forms a kind of cap ; its front margin is sharply edged by a flat plate forming inside an angle with the upper part of the labrum ; in fact this plate is the front margin of the labrum bent down very suddenly ; the mask reaches this flat plate and never exceeds it.

3. The mask is flat, reaching to the forelegs, quadrangular or oblong ; the middle third of its front margin is straight, or advanced in a more or less produced rounded lobe, with short pavement teeth and a comb of flat scales ; this lobe has sometimes one cylindrical tooth in middle, or even two separated teeth ; in one instance the lobe is cleft ; the palpus is small, just reaching the opposite one, rounded on tip or strongly hooked, serrated or dentated on its inner margin, or plain.

4. The prothoracic stigma is free, uncovered ; the abdomen, twice as long as broad, lancet shaped, or narrower and more elongate, spindle shaped ; two longitudinal ventral sutures ending in apical angles of 9th segment divide the venter in three equally broad spaces ; ventral bags on the base of segments 4 to 6 ; segments of about equal length, but the 9th mostly longer than 8th, and the 10th short, even very short ; in one instance longer than 9th ; appendages short, pyramidal, pointed, the inferiors a little longer than the superior, which is again longer than the laterals ; lateral spines present on segments 7 to 9, or 6 to 9 ; rarely on 5 to 9, or even on 2 to 9 ; exceptionally only on 6 to 7, and once rudimentary only on 9 ; dorsal hooks more or less developed on segments 2

to 9, or on some of them, or entirely wanting, and then some of the segments 5 to 8, or less divided in two halves by an impressed longitudinal middle line.

Of the 21 subgenera accepted by De Selys, only 4 are known by raised nymphæ, and 3 more by supposition; of the 113 species in De Selys last list, to which now are to be added about 40 more, only 12 are known by raised nymphæ, and 17 only by non-raised nymphæ, for which, in a few cases, supposition is tried. It is to be presumed, of course, that the four-fifths of the species not yet known may modify the given characters and necessitate, perhaps, for some of the subgenera a higher standing.

In 1872 Mr. L. Cabot described 8 species, of which only 2 were raised, all of which were contained in the collection of the Museum.

Of the now described 29 species 21 are from the West Indies and Mexico, 4 from Brazil, 4 from East India and 1 from Europe, of which 12 were raised. There are known now 61 species from the United States and Mexico, so that the known nymphæ represent one-third of the known imagos.

The very important question whether the nymphæ corroborate the adopted subgenera or groups cannot yet be considered seriously, because only 4 of the 21 subgenera are represented by raised nymphæ. After all some remarks seem not to be out of place.

Two species may be excluded directly from the others by some very heterogeneous characters.

1. The species referred to as possibly belonging to *Cyclogomphus* has the lobe on the middle third of the front margin of the mask deeply cleft. This character is quite unique for *Gomphus* and combined with the lack of the apical hooks of the anterior tibiæ seems to indicate a higher position than a subgenus. It is the most aberrant nymphæ among those known of the genus *Gomphus*.

2. The species from Brazil supposed to belong to *Epigomphus*. The unusual length of the 10th segment of the abdomen and the also unusual occurrence of two teeth on the lobe of the front border of the mask seem to indicate a higher position than a subgenus. The length of the 10th segment corresponds well with *Epigomphus*, and was indeed the reason for my supposition.

The known nymphæ, the two just spoken of excepted, are divided in two large groups:

1. The palpus is without terminal hook, not dentated; the middle third of the front margin of the mask produced in a rounded lobe; ten specimens.

2. The palpus has a sharp terminal hook and is dentated; the middle third of the front margin of the mask is cut straight (some exceptions to be mentioned); eighteen specimens.

The first group belongs to *Onychogomphus*, *Herpetogomphus* and *Ophiogomphus*.

*Onychogomphus* known by but one Asiatic species differs from the others by the prismatic shape of its body, rather similar to *Progomphus* and by the exceptionally large number of lateral spines on segments 2 to 9, characters perhaps to be modified by other species. In this neighborhood is to be placed the nympha from the Himalaya with a long triangular lobe of the mask; perhaps it belongs to *Heterogomphus*.

The nympha of *Herpetogomphus* (three specimens) and *Ophiogomphus* (five specimens) so similar one to the other that I could not find any differences, are directly separated from *Onychogomphus* by the flat lancet-shaped abdomen.

The nymphæ of the second group (eighteen specimens) are somewhat polymorphic. The species belonging to the group of *G. plagiatus* represent a type different from the others by the very long spindle-shaped abdomen, which is not broader than the head, by the length of 9th segment, by the small hook on the anterior tibia and by only two or three teeth near the terminal hook of palpus. The burrowing for a narrower spindle-shaped abdomen is obviously easier, and explains the smallness of the hook of the tibia. To this group belongs *G. plagiatus*, *G. notatus*, *G. spiniceps* and perhaps *G. olivaceus*. Of the latter species the male is not yet known, and the rounded lobe of the mask, which is wanting in the other species, makes its place in this group doubtful.

The nympha of *G. pallidus* and of the species supposed to belong to *G. pilipes* by Mr. L. Cabot are exceptional by the shape of the abdomen, which is broad, flat and slopes strongly at tip, the 9th segment long; the mask has a rounded lobe with a cylindrical tooth in the middle. The length of the 9th segment corresponds with the length of this segment in the imago as well as for the group of *G. plagiatus*.

Another group is represented by *G. vulgatissimus* and three not raised species. The flat lancet-shaped abdomen has the dorsal segments 3d to 8th or less, divided by a sharply impressed middle line in two halves; the mask straight, the palpus strongly dentated.

The last group, all North American species, only two of them raised, have the dorsal segments not divided, but with strong dorsal hooks, the abdomen is less flat and mostly narrower, the mask straight, the palpus dentated, mostly from base to tip. To this group belongs *G. vastus*, *G. exilis*, and related species.

The nymphæ actually known are certainly not sufficient for more stringent conclusions. The existence of at least two large groups (palpus with terminal hook or without it, corresponding with the difference in the front margin of mask) is proved; if there exist more, as it is possible, and indicated by the nymphæ supposed to belong to *Cyclogomphus* and *Epigomphus*, farther experience has to decide.

The question of accepting a higher rank than that of subgenus for some of the groups now proposed, can only be decided after a sufficient knowledge of the nymphæ of the other subgenera accepted for known imagos.

Sub-genus *ONYCHOGOMPHUS* (raised).

Head cordate; antennæ rather slender. 3d joint long, cylindrical, 4th short, one-third as long as 3d, conical; mask one-fourth longer than broad, middle third of front margin produced in a rounded lobe with pavement teeth and a comb of flat scales; palpus triangular, tip rounded and a little bent; movable hook long, sharp; abdomen three times as long as broad, scarcely broader than the head, all segments of equal length, the four apicals tapering; dorsum slightly rounded; lateral spines on segments 2 to 9; only indications of dorsal hooks; genital parts not marked; appendages a little longer than last segment, triangular, sharp, the inferiors a little longer; legs short, strong, 3d joint of posterior tarsi visibly longer than the two basal ones.

The nympha resembles those of *Progomphus obscurus* in shape, but is easily separated by the equally distant four anterior legs. The nympha is known of but one of the twenty-two described species, therefore the genus character may have to be modified, when more species are known.

1. ***Onychogomphus lineatus*** (raised).

Selys. Monogr. Gomph. p. 48.

In alcohol fifteen nympha skins and nymphæ full grown or less, one very young. With the nympha skins a teneral male imago.

From swamps of East Jumna, a holy tank near Delhi, East India; Rev. M. M. Carleton, 1875. Length 21–27 mm.; young, 11 mm.

Body rather prismatic; abdomen as broad as head, three times longer than broad; head and antennæ very hairy; joints 1 and 2 short, 3d long, cylindrical, rather stouter at tip, which is truncate; 4th small, conical, one-third of 3d; mask reaching first legs, one-fourth longer than broad, middle third of front margin produced in a rounded lobe about four times broader than long, with square pavement teeth; above and before the teeth are inserted in a short, rounded base flat scales, forming a comb, four times longer than the teeth; the scales are divided by longitudinal folds more strongly marked at tip, which is not split, though it looks so, being folded up; palpus triangular, tip rounded, a little curved; movable hook much longer, sharp; the inner margin of both with faint linear impressions; mandibles with four lancet-shaped teeth at tip, the inner ones shorter; second row very small; between two sharper teeth are five very small

ones: maxillæ above with four strong spines, below with three shorter ones; palpus as long as the superior spines, but stouter; wing cases covering partly 4th segment; abdomen not very broad, all segments of nearly equal length; the last four tapering; lateral spines on segments 2 to 9; dorsal hooks only indicated on segments 2 to 9 by somewhat thickened round lobes, a little larger on segments 2 and 3; appendages a little longer than the last segment, sharp, the inferior ones a little longer; abdomen above on segments 2 to 9 with four rows of blackish spots, one on each side nearer to the margin, the others near the middle forming with the dorsal hooks a kind of "fleur de lis;" legs short, strong, adapted for burrowing; hind legs a little longer, reaching segment 5.

The wing cases of the smallest nymphæ covering only half of segment 1; lateral spines only on segments 5 to 9; no dorsal hooks; last joint of antennæ longer and stouter; the vertum with the gills is left in the nymphæ skin. Indications of the genital parts are not visible; middle field between the two ventral sutures as broad as the lateral ones.

The nymphæ of *C. lineatus* is similar to those of *Prog. obscurus*, but directly to be recognized by the equally distant fore- and middle legs; in *Prog. obscurus* the middle legs are less distant from each other, than the fore legs.

## 2. *Gomphus* spec.

Two nymphæ in alcohol, one young, the other not full grown; from the Sutledge River above Billespur, Himalaya, by Rev. M. M. Carleton, 1872. Length 20-21 mm.

Body stout, very hairy; head cordate, short, nearly straight behind, somewhat less in the younger one; hind angles oblique, rather sharp; antennæ short, third joint very little longer than twice the length of the two basal ones and scarcely broader, cylindrical, bent a little, truncate; fourth joint as long as the tip of third, broad, short, ovoid; mask as long as broad, concave in middle, sides oblique, base one-third shorter than front margin; middle third produced in a triangular lobe, three times broader than long, tip strongly rounded, with a comb of flat scales; palpus short, triangular, rounded above, tip nearly sharp, a little bent, very little serrate; movable hook long, bent, sharp; wing cases covering half of third segment; abdomen three times longer than broad, segments of equal length, 10th one-third of the foregoing; dorsum flatly rounded, no dorsal hooks, apical margin of 9th with a small triangular hook in middle; lateral spines on segment 7th to 9th strong, sharp, the last nearly as long as segment 10th, lateral margin of those segments with a series of small teeth; scars as usual; genitals not marked; appendages twice as long as 10th segment, triangular, sharp, the laterals a little shorter; legs long, anterior not much thicker than posterior, which reach half of 7th segment; third joint of posterior tarsi scarcely longer than second.

The species and group of these nymphæ are unknown; the principal characters are:—the shorter head, straight behind, with marked angles; the shorter mask with triangular lobe, without visible pavement teeth; the short palpus, triangular, the tip sharp, a little bent; the flat, long abdomen with strong lateral spines on 7 to 9, and no dorsal hooks; the long legs. The larger nymphæ shows that it has still to undergo a change

of the skin. Perhaps they belong to some of the large Indian species, *Macrogomphus* or *Heterogomphus*; the place after or near *Onychogomphus* seems to be indicated by the palpus and the front border of the mask.

Sub-genus *HERPETOGOMPHUS* (raised).

The species belonging now to *Herpetogomphus* were at first described in De Selys Synops. Gomphin. p. 20, as a separate group of *Ophiogomphus*. Later (Monogr. Gomphin p. 70) a new sub-genus *Herpetogomphus* was proposed because the male organs proved to be remarkably different. *Ophiogomphus* and the larger part of all sub-genera of *Gomphus* have the second joint of the penis longer than the third and below with a long basal tooth directed to the tip of the joint. *Herpetogomphus*, *Ceratogomphus*, *Onychogomphus* and *Anormogomphus* have the second joint of the penis shorter than the third and without tooth, but the third joint has two small spines directed to the base of the joint. The consequence of such differences in the male organs lead us to suppose analogous differences in the female organs and are, as far as I know, generic differences. Later De Selys, in four additions Synops. Gomph. and in Compt.-Rend. Soc. Ent. Belg. May 3, 1879, has denied the generic importance of this character and has given other characters to separate the sub-genera *Herpetogomphus* and *Ophiogomphus*. There are known now ten species belonging to each of those sub-genera. All *Herpetogomphus* are North American species, and as I believe representing in America the sub-genus *Onychogomphus*, which belongs to the old world. I have to confess that the previous stages seem not to confirm my views. The nymphæ differ essentially from those of *Onychogomphus*, and are so entirely alike to those of *Ophiogomphus*, that I am not able to find any difference between them.

3. ***Herpetogomphus designatus*** (raised).

Hagen Monogr. Gomphin. p. 401.

Two nymphæ skins, one with the teneral female on the same pin. San Antonio, Texas, by Mr. A. Agassiz; a male nymphæ skin from Dallas, Texas, in McLachlan's collection. Length 25 mm.

Head strongly cordate, deeply notched behind: eyes very prominent; antennæ stout, little longer than labrum, third joint less than twice as long as the two globular basal ones, somewhat larger on tip, flattened above: fourth very short, pyramidal; mandibles with four teeth at tip, the interior longest, the others successively shorter; second row narrower, curvate; mask quadrangular, little narrower at base, middle third produced in a short rounded lobe, with fine pavement teeth and a comb of scales; palpus short, straight, rounded on tip, very finely

serrate; movable hook short, sharp; prothorax short, lateral angles rounded; wing cases covering segment 4; abdomen half as broad as long, tapering to base and to tip; convex above; segments of equal length, only tenth less than half as long; lateral spines on segments 6 to 9, the last one half as long as segment 10; dorsal hooks strong on segments 2 to 4, only indicated on the following ones, represented on 8 and 9 by the middle of the apical border produced; segments 2 to 9 on each side with a scar and a small linear brown spot; part between the ventral sutures as broad as the lateral ones; appendages twice as long as segment 10, very sharp, the lateral ones very little shorter than the others, female genitals represented by two cylindrical knobs at the end of 8th segment; legs rather slender, the four anterior fitted for burrowing; hind ones reaching segment 7; the whole body very little hairy on the legs and abdominal margin.

A very small nympha, length 15 mm., from Arizona, belongs to the same species by the number of lateral spines and the dorsal hooks; the hind femurs are blackish at base and before tip; the segments have besides the linear spots one spot on each side near the middle line; the dorsal hooks are dark, a brown spot near the lateral margin of the segments.

4. **Herpetogomphus Menetriesii** (supposition).

Selys Synops. Gomphin. quatr. addit. p. 24.

A nympha from Guatemala. Length 18 mm.

The probably young nympha has lateral spines on 6th to 7th segment and very strong developed dorsal hooks, all erected on segments 2 to 9; the last segment a little longer than in *H. designatus*; appendages all of nearly equal length; wing cases covering half of segment 4.

The spines and horns of the abdomen seem to exclude the possibility of bringing the nympha to the other described species, though all other characters agree with the genus.

The only species known from Guatemala is *H. Menetriesii*.

5. **Herpetogomphus compositus** (supposition).

Hagen Monogr. Gomph. p. 400; Cabot p. 4, No. 6, pl. 2, fig. 6.

Five nymphæ in alcohol, the largest one probably full grown, from Poole's Creek, N. Mexico (formerly W. Texas) by Capt. Pope's expedition. Length 24-14 mm.; breadth 7-5 mm.

The largest nympha is described by Mr. Cabot and agrees so well with those of *H. designatus* that there cannot be any doubt about its generic position. *H. compositus* (imago) was collected also by Capt. Pope; the size and similarity of *H. designatus* and *H. compositus* make the determination very probable.

The nympha differs from *H. designatus* by joint three of antennæ shorter, more dilated, fourth a little longer, conical; dorsal hooks on segments 2 to 9 well developed, on the last segments represented by tri-



angular, sharp prolongations; lateral spines only on segments 7 to 9; lateral appendages shorter than in the other species; legs and abdomen rather more hairy; no linear blackish spots on the segments; the smaller nymphæ with less marked dorsal hooks.

The large nympha Cabot p. 1, pl. 1, fig. 2, formerly supposed to belong to *Herpetogomphus* is now described as *Epigomphus*.

Sub-genus *OPHIOGOMPHUS* (raised).

Head cordate; antennæ stout, joint three enlarged, fourth very small, conical or rudimentary; mask quadrangular, scarcely longer than broad, a little narrowed at base; middle third produced in a very short rounded lobe with pavement teeth and a comb of flat scales; palpus short, straight, rounded at tip, very finely serrate; movable hook short, sharp; abdomen lancet shaped, about half as broad as long, dorsum roof shaped; lateral spines short on segments 6 to 9 or only on 7 to 9; dorsal hooks on segments 2 to 9 sometimes merely indicated on the middle segments; segments of nearly equal length, 10th only half as long; the four apical segments tapering; genitals of both sexes visibly marked: appendages longer than last segment, triangular sharp, the lateral ones a little shorter; legs short, the four anterior equally distant at base, the posteriors more separated; joint three of posterior tarsi as long or longer than the two basal ones.

The nymphæ of *Ophiogomphus* are very much alike to those of sub-genus *Gomphus*, but visibly stouter. There is no difference among the nymphæ of *Ophiogomphus* and *Herpetogomphus*.

The nympha is described for six of the ten known species.

6. ***Ophiogomphus colubrinus*** (raised).

Selys Monogr. Gomphin. p. 76.

A dry female nympha with the imago half transformed.

Orono, Maine, by Prof. Fernald. Length 23 mm.

Head strongly cordate, eyes prominent; antennæ short, third joint less than thrice the length of the two basal ones, flat, very much enlarged to tip; fourth joint rudimentary, represented by a larger rounded knob, a little pointed internally, forming the tip of joint three; mask quadrangular, narrowed at base, middle third produced in a short rounded lobe with pavement teeth and a comb of scales; palpus short, straight, somewhat narrowed to the rounded tip, very finely serrate; movable hook sharp, not reaching the base of the opposite one; wing cases covering segment 4; abdomen half as broad as long, tapering on tip, convex above; segments of equal length, only 10th half as long; lateral spines short, on segments 7 to 9; dorsal hooks forming rounded lobes on segments 2, and 7 to 9, very little indicated on the others; a scar on each side of the segments and some ill defined darker spots; part between the ventral sutures as broad as the lateral ones; female genitals represented by two small brown knobs; appendages about twice as long as segment 10; triangular, sharp, laterals one-third shorter; legs short, slender; joint three of posterior tarsus longer than the two basals together.

In the collection of Mr. McLachlan, England, is a nympha skin with the just emerged imago from Newfoundland, labeled: Terra Nova River,

emerging from case while on a stone July 22, 1874. The pinned imago is a male not yet stretched out. After a careful comparison with the only male in the collection of *C. colubrinus* it belongs very probably to this species. If not, it is a new species. The skin is in good condition, 26 mm. long, and similar to the female skin just described. The differences are small, possibly sexual, and perhaps due to the bad condition of the female skin. The third joint of antennæ is not so much enlarged at tip, and the fourth joint is a short cone; in the female these parts are much compressed. The wing cases reach only half of segment 4. The dorsal hooks of the abdomen are equally well developed on segments 3 to 6. The middle appendage has before the apical third above on each side a rounded blackish tubercle. After all I think the male and the female belong to the same species.

7. **Ophiogomphus carolinus** (supposition).

Hagen, *Oph. carolinus* n. sp.

One female nymph skin, from Bee Spring, Ky., May, 1874, by Mr. F. G. Sanborn. Length 26 mm.

Body stout, moderately hairy; head cordate, little notched behind, angles rounded, globular; joint three of antennæ less than thrice the length of the two basals, flattened, bent upon tip, enlarged externally to about one-third of its length; tip rounded; fourth joint rudimentary, short, conical; mask quadrangular, a little longer than broad, narrowed at base; middle third produced in a short rounded lobe, with pavement teeth and a comb of flat scales; palpus just meeting; a short, nearly straight lobe, narrowed to the rounded tip, faintly serrate inside; movable hook sharp, slender, bent; wing cases covering part of segment 4; abdomen stout, convex above, a little more than twice as long as broad; segments 8 to 10 tapering more suddenly; segments of equal length, 10th half as long as 9th; lateral spines short, sharp on 7 to 9; dorsal hooks of equal size on 2 to 9; scars as usual; genitals marked; last segment tapering; appendages twice its length, triangular, sharp; laterals a little shorter; legs slender, posteriors reaching about segment 7; joint three of posterior tarsi longer than the two basals.

This species is evidently an *Ophiogomphus*, but no species of this genus was described from the Middle States. Among the described nymphæ it is nearest related to *O. colubrinus*, but this species has the third joint of antennæ shorter, broader, and the dorsal hooks visibly less developed. As now a pair of new species *O. carolinus* Hag. from North Carolina is discovered, the supposition that the larva may belong to this species is probable. Of all other known species only *O. rupinsulentis* goes as far south as New York. Its larva is still unknown.

8. **Ophiogomphus severus** (raised).

Hagen, Hayden Rep. 1873, p. 591.

Three nymphæ in alcohol from Colorado, one full grown, by Mr. Hayden, one very young by Mr. Carpenter; seven skins of both sexes from Umatilla, Oregon, June 25, and Weeksville, Mont., Aug. 2, 1882, by Mr. S. Henshaw. Length 27 to 29 mm.; young, 11 mm.

Head cordate, eyes prominent; body hairy, less on the abdomen; antennæ short: third joint less than thrice the length of the two basal ones, flat, concave above, enlarged after base, but not to the tip, which is rounded; fourth joint very short and thin, conical; mask as *O. colubrinus*; wing cases covering nearly 4th segment; abdomen half as broad as long, tapering on tip, somewhat flattened; segments of equal length, the 10th shorter; lateral spines short, on segments 7 to 9; dorsal hooks on segments 2 to 9 stronger and more exerted on segments 2 to 4; scars as usual: female genitals two small yellowish knobs; appendages less than twice the length of last segment, triangular, jointed, the laterals a little shorter; legs slender, somewhat longer than in *O. colubrinus*, third joint of posterior tarsi as long as the two basal ones.

The young nymphæ entirely similar, but the wing cases covering only the 2d segment.

We caught the teneral imago near the skin, and as the *O. occidentis* flying at the same time and place has been actually taken during transformation, the statement "raised" seems justified, the more as the identity of the nymphæ is proved by the specimens from Colorado, where no other *Ophiogomphus* but *O. severus* has been observed.

9. **Ophiogomphus occidentis** (raised).

Hagen, nov. spec.

Ten nymphæ skins of both sexes from Umatilla, Oregon, June 25th, Big Bend of Yakima River, Washington Territory, July 19, 1882, by Mr. S. Henshaw; full grown nymphæ in alcohol from Washington Territory opposite Umatilla June 27, 1882, by H. Hagen. Length 28 mm.

Very similar to *O. severus*; differs by lateral spines on segments 6 to 9; dorsal hooks all strongly erected, the last two with the tip bent backwards; a black dot on each side of the dorsal hooks and a row of ill defined spots more externally; lateral appendages one-third shorter than the middle one: third joint of posterior tarsi somewhat longer than the two basal ones.

This is the species of which I have given in "Nature" (No. 686, vol. 27, Dec. 21, 1882, p. 173) some notes concerning its tracks on the sand when ready for transformation into the imago state.

10. **? Ophiogomphus** spec (supposition).

Six nymphæ, not full grown, in alcohol, from the Sutledge River above Billespur, Himalaya, by Rev. M. M. Carleton, 1872. Length 23 to 20 mm.

Head cordate, eyes prominent, body hairy; antennæ short, stout, third joint less than thrice the length of the two basal ones, flat, ovoid, very little bent inwards, the apical third about half as broad as long; fourth joint rudimentary, represented by a small tubercle with a faint black dot on tip; mask one-third longer than broad, quadrangular, the basal third narrowed; middle third produced in a short rounded lobe, with pavement teeth and a comb of flat scales; palpus short, straight, somewhat narrowed to the rounded tip, very finely serrate; movable hook reaching scarcely the base of the opposite one, sharp, straight, bent a little on tip; wing cases covering the base of 4th segment, abdomen elongate, about one-third broader than long, little broader than the head, slowly tapering, segments of equal length, 10th shorter; lateral spines none except a rectangular production of segment 9; dorsal hooks on 2 to 9, less developed on segments 4 to 6; scars as usual; genital not marked; appendages twice as long as segment 10, triangular, very sharp, the laterals one-third shorter; legs short, slender, posteriors not exceeding 6th segment; third joint of posterior tarsus longer than the two basals together.

The place of this species is doubtful, the more as the want of marks of genitals may prove that the nymphæ are far from full grown; nevertheless, the principal characters are those of *Ophiogomphus*, differing by a little longer mask, more straight movable hook, longer more cylindrical abdomen and lack of lateral spines. There is indeed a species from Northern China described *O. spinicornis* Selys, said to be nearly related to *O. serpentinus*. As the nymphæ of the latter species is still unknown I feel not warranted in supposing that the described nymphæ may belong to the only known Asiatic species.

Sub-genus GOMPHUS (raised).

Selys Monogr. Gomphin. p. 115.

Body flat, broad; third joint of antennæ twice the length of the two basals; mask quadrangular, middle third of front border straight, or nearly so; palpus with a strong end hook, dentate before it; abdomen flattened, broader than the head, two to three times longer than broad, segment 9 little longer than 8; 10th shorter; lateral spines on 6 to 9, or 7 to 9; dorsal hook very faint on 9, or more developed on 3 to 9, or on 6 to 9; legs with strong hook on tibia; third joint of posterior tarsi as long as the two basal.

This group is still somewhat polymorphous, as *G. vulgatissimus* has been considered the type with *G. adelphus*?, *fraternus*?, *exilis minutus*?, *furcifer*?, and perhaps *amicola*? and *graslinellus*?. To a somewhat different group, perhaps of higher value, belongs *G. spinosus*?. Finally, two species from the Amazon and Himalaya are more different. I have avoided any farther division, as of the fifteen species described only four are raised, and as of the other ones only for few of them can a somewhat risked supposition be made.

11. **Gomphus vulgatissimus** (raised).

Selys Monogr. Gomphin. p. 128, Cabot p. 3, pl. 1, fig. 1.

Many nymphæ skins of both sexes from Prussia, Hanover, Bavaria, England and two nymphæ in alcohol from Bavaria and Austria raised by Rosenhauer and by F. Brauer. Length 31 mm.

Body stout, not much hairy; head cordate, notched behind, angles rounded, third joint of antennæ nearly twice as long as both basals, a little dilated, bent up at tip; fourth rudimentary; a short tubercle; mask quadrangular, channeled below, as long as broad, a little narrowed at base, middle third of front border straight, with a comb of flat scales; palpus short, arcuated, basal half finely denticulated, end hook stout, sharp; movable hook long, sharp, bent; wing cases reaching nearly 4th segment; abdomen three times longer than broad, flattened, lancet shaped, tapering, after 6th segment decreasing; segments of equal length, the 9th a little longer than 8th; the 10th one-third of the 9th, cylindrical; lateral spines on segments 6 to 9; no dorsal hooks; apical margin of 9th segment produced in middle in a very short and faint triangular tooth, which is wanting sometimes; a faint impressed median line on 5 to 8; scars as usual; genitals marked; appendages a little longer than last segment, pyramidal, sharp, laterals shorter; legs long, not very strong, posteriors reaching nearly 9th segment; third joint of posterior tarsi about as long as the two basals.

12. **Gomphus** spec.

One nymphæ in alcohol from Illinois, Prof. S. A. Forbes, and a very young one from Mackinaw Creek, Woodwood County, Illinois, Aug. 20, 1879. Length 27 mm.; breadth 7 mm.

Body lancet shaped, flat; antennæ, legs and side margins of abdomen very villos; head cordate, flat; ocelli visible; occiput short, notched in middle, with a triangular short lobe on each side of the notch; hind angles rounded, with several stripes; antennæ short, third joint one and a half longer than the basals, curved; fourth a short pyramidal tubercle; mask oblong, one-third longer than broad, a little narrowed at the base; middle third of front border very slightly rounded; palpus nearly straight, tip rounded, end hook not longer than the teeth, dentated to base; movable hook long, strong, wing cases covering 2d segment; abdomen a little more than twice longer as broad, only the last segments sloping; segments of equal length, 10th one-third of 9th; lateral spines on 6 to 9 long, flat, triangular, those of 9th as long as 10th segment; side margins of 8 and 9 serrated; no dorsal hooks, segments 3 to 7 divided above, a triangular short spine on middle of apical border of 8 and 9; appendages little longer than last segment, pyramidal, pointed, the median shorter than the inferiors; the laterals one-third shorter than inferiors; legs strictly burrowing legs, the hind ones reaching 2d segment; the wing cases cover only 2d segment.

The smaller nymphæ, 12 mm. long, is exactly alike, only the wing cases very small. Should they belong to *G. amnicola*? This species is similar to *Ophiogomphus* by the front border of mask very slightly rounded and the palpus nearly without end hook, but the shape of the abdomen and the divided median dorsal segment by an impressed median line are similar to *G. vulgatissimus*. The segments 8th to 9th serrated on lateral margin.

The fact that the wing cases of the larger nymphæ, 27 mm. long, do not cover entirely the 2d segment proves that even this nymphæ is still a young one, and must, when full grown, belong to a very large species.

13. **Gomphus adelphus** (supposition).

Selys Syn. Gomphin. iv, p. 52.

One full grown nymphæ, male, from Cambridge, Mass. Length 29 mm.

Similar to *G. vulgatissimus*, body flatter and more hairy; head cordate, notched behind, angles blunt; third joint of antennæ about twice as long as both basal, little dilated, bent up, fourth very short, ovoid; mask quadrangular, a little longer than broad, channeled a little before tip, retracted near base; middle third very slightly rounded but not produced, with a comb of flat scales; palpus short, broad, bent; a finely dentated end hook is short, stout, not much longer than the teeth; movable hook bent, long, sharp; wing cases reaching 4th segment; abdomen half as broad as long, flat, sides straight, the last four segments strongly tapering, segments of equal length, the 9th a little longer than 8th and more on its ventral side; segment 10 very short, one-fourth of the 9th, cylindrical; lateral spines on 6 to 9, the first very short, the following longer, the 9th very long and sharp, twice the length of segment 10, which appears, consequently, encased in the 9th; side margins of 9th serrated; dorsal hooks none, except a small tubercle in the middle of apex of segments 8 to 9, a little more produced on 9; scars as usual; genitals marked; appendages twice as long as segment 10, pyramidal, broad, sharp, the middle one with a tubercle on each side, laterals a little shorter; legs strong, the anteriors shorter, posteriors flattened, long, reaching 9th segment; third joint of its tarsi about as long as the two basal.

Among the few species known from Massachusetts, *G. adelphus* is the only one to which it can be supposed to belong.

The nymphæ is very similar to the preceding one.

14. **Gomphus** spec.

Three nymphæ, the larger one probably full grown, from Cairo, Ill., July 26, 1876, Prof. Forbes. Length 18 to 23 mm.

Similar to the nymphæ from Newport, Ky., but surely different; body flat, limbs very hairy; third joint of antennæ longer, more cylindrical, fourth nearly black; ocelli well visible; palpus with only two incisions near the strong and sharp end hook; middle third of front margin of the mask slightly rounded; wing cases covering fully 3d segment; abdomen similar, flat, side margins very hairy; segment 9 as long as 8, 10th very short; lateral spines on 6 to 9, the last one less sharp, as long as segment 10; no dorsal hooks at all; appendages as long as segment 9, triangular, broad, not very sharp, laterals a little shorter than the middle one, which is shorter than the inferiors; legs slender, longer, posteriors reaching segment 8; end hook of anterior tibiæ short; third joint of posterior tarsi as long as the two basals.

This species, together with the following nymphæ from Newport, Ky., with the nymphæ from Cambridge (supposed *G. adelphus*) and with the European *G. vulgatissimus* have a sharp impressed dorsal line seemingly cutting the abdominal segments in two halves.

15. **Gomphus** spec.

One young nympha from Newport, Ky., by Miss Willard, 1881. Length 23 mm. Body flat, hairy; differs as follows from the nympha supposed to belong to *G. fraternus*.

Third joint of antennæ a little longer, more cylindrical; fourth rudimentary, black: mask nearly one-half longer than broad, somewhat sloping to base; middle third straight; palpus as by *G. fraternus*, but only three strong teeth near tip; wing cases reaching 3d segment; abdomen flat, three times longer than broad, a little increasing to 7th segment, the rest tapering slowly; segment 9 one-third longer than 8; segment 10 very short, one-sixth of 9th: lateral spines on 6 to 9 sharp, the last one twice the length of segment 10; dorsal hooks none, but the apical margin of 9th segment with a broad, triangular, flat projection, in the middle as long as segment 10; appendages twice the length of last segment, triangular, broad, sharp, the laterals nearly as long as the other; legs slender, shorter, posteriors reaching segment 7, third joint of posterior tarsi as long as the two basals.

There is no clew for the species to which the nympha belongs. Perhaps it may be *G. minutus*.

16. **Gomphus exilis** (raised).

Two nympha skins, one of them raised by Mr. F. Sanborn in Worcester, Mass., May 25, 1878, and two younger nymphæ from Brookline and Salem, Mass. Length 24 to 19 mm.

Body rather slender, moderately hairy; head cordate, notched behind; angles blunt; third joint of antennæ about twice as long as both, basal little dilated, bent up, flat above, truncate on tip, fourth joint very short, ovoid: mask quadrangular, a little longer than broad, narrowed at base, front border very faintly rounded on middle third, which is not produced, with a comb of flat scales; palpus scarcely meeting, ending in a strongly bent and pointed hook with four strong teeth inside; movable hook long, slender, arcuate: wing cases reaching partly 4th segment: abdomen a little more than three times longer than broad, flat, tapering slowly after 6th segment; segments of equal length, 9th a little longer than 8th; 10th half of 9th, cylindrical, ventral margin a little produced in the middle; lateral spines on 6 to 9, the last one-third of 10th: dorsal hooks very small, pointed on 6 to 9; scars as usual; genitals marked by both sexes; appendages as long as last segment, pyramidal, broad, sharp, laterals a little shorter: legs slender, long, posteriors reaching nearly 9th segment, third joint of its tarsi scarcely longer than second.

Eleven nymphæ in alcohol from Kentucky by Mr. F. G. Sanborn; all stages from full grown 26 mm. to very young 12 mm. are very much alike to those of *G. exilis*. The head of the younger nymphæ is only half as broad as the abdomen, which is very flat; the dorsal hooks in some are indicated on segments 2 to 9. As *G. exilis* is found in Maryland it may exist also in Kentucky; the tarsi are yellow.

A full grown nympha 27 mm. long from the Potomac, Virginia, August, by Prof. Shaler I am not able to separate from those from Ken-

tucky; nevertheless the full grown ones are so much longer, broader and flatter, that they may belong to another related species.

17. **Gomphus** spec.

Selys Monogr. Gomphin. p. 125.

One nympha, perhaps nearly full grown, from Delphi, Ind., by Rev. Hill. Length 30 mm.

Very similar to *G. adelphus*; differs as follows: palpus narrower, the tip is a very sharp bent hook, inside with ten strong teeth from base to tip; middle third of mask straight; wing cases covering half of 4th segment; abdomen a little narrower, more slowly tapering; segment 9 a little longer, narrower on tip, three times longer than 10th; lateral spines on 6 to 9 longer, sharper, the last about as long as segment 10; lateral margins of 7th to 9th serrate; dorsal hooks well marked on segments 2 to 9 somewhat less elevated, but more sharply pointed; genitals not marked; appendages as long as last segment, laterals shorter; legs similar.

Though there is no proof I think the nympha may belong to *G. fraternus*, or perhaps to some nearly related species.

18. **Gomphus Grastinellus** (supposition).

Walsh. Proc. Ac. Phila. 1862, p. 394.

One female nympha skin from Loon Lake, Colville Valley, Washington Territory, July 23, 1882, by Mr. S. Henshaw. Length 30 mm.

Body flat, little hairy; head cordate, notched behind, angles globular, rounded; only the two basal joints of antennæ present; mask quadrangular, one-third longer than broad, channeled below, basal third narrowed; middle third produced in a short rounded lobe, with a comb of flat scales; palpus short, broad, on tip a sharp, end hook, below finely dentated to base; wing cases covering half of 4th segment; abdomen flat, less than three times longer than broad, the last five segments slowly tapering; segments of equal length, 9th a little longer, 10th half as long as 9th, conical; lateral spines on 7th to 9th; lateral margins of 8th and 9th serrated; dorsal hook on 4th to 9th well developed; scars as usual, genitals marked; appendages about as long as 10th segment, pyramidal, sharp, laterals a little shorter; legs strong, for burrowing; hind legs flat, long, reaching about 2d segment; tarsi wanting.

This nympha and one female of the imago were found in the same locality; no other *Gomphus* was found there; so the supposition seems to me warranted.

A number of young nymphæ, 10 to 25 mm. long, from shallow water North shore Cedar Lake, Illinois, Oct. 18, 1882, communicated by Prof. Forbes, belong to this species described by Mr. Walsh from Illinois; they agree perfectly with the nymphæ from Washington Territory. The third joint of antennæ twice as long as the basals together, stout, cylindrical, a little thicker before tip; fourth joint a short pyramid; the lateral spines and the dorsal hooks well developed; lateral margins of segments 8 to 9 strongly serrated, and some teeth also on 7th; third



joint of posterior tarsi as long as the two basals together. The nymphæ are of dull yellow color, segments 2 to 8 on dorsum with two divergent blackish bands, and another ill defined longitudinal one externally.

A male nympha skin 32 mm. long from Dallas, Texas, in McLachlan's collection agrees well in all characters, except that the lateral margins of segments 8 to 9 are very little serrated, but I have overlooked also this character in the dry female skin till I got alcoholic specimens. Moreover, the abdomen is less depressed, and so it looks much narrower, but this may be the effect of transformation or a sexual character; dorsal hooks sharp on segments 3 to 9; the alcoholic specimens show also a hook on third segment; nevertheless the narrower abdomen makes it not impossible that the specimen may belong to a nearly related but different species.

19. **Gomphus** spec.

One male nympha skin from Detroit, Mich., by Mr. H. G. Hubbard. Length 22 mm.

Body elongate, somewhat hairy; head cordate, notched behind, angles globular; third joint of antennæ twice the length of the two basal, cylindrical, bent up, flattened above, truncate on tip; fourth joint rudimentary, a short tubercle; mask large, a little longer than broad, sides bent up, straight in the apical half, oblique to the base, channeled below; middle third of front border straight, with a long comb of flat scales, and a short, black tooth in the middle; palpus short, broad, strongly arcuate, end hook sharp, before it a series of sharp teeth to the base; movable hook long, bent, sharp; wing cases reaching 4th segment; abdomen spindle shaped, more than thrice longer than broad, about equally rounded above and below, sloping after segment 6; segments of equal length, 9th a little longer than 8th, on tip half as broad; 10th cylindrical, half as long as 9th; lateral spines on 6th to 9th, the last half as long as 10th; dorsal hooks on 3 to 9, the last ones being sharp spines; scars as usual, genitals marked; appendages a little longer than last segment, triangular, sharp; laterals one-third shorter; legs for burrowing, rather long, hind legs reaching 8th segment; third joint of posterior tarsus as long as the two basal.

Perhaps the nympha may belong to *G. furcifer*; its shape is similar to *G. notatus*.

20. **Gomphus vastus** (raised).

Walsh, Proceed. Ac. Sci. Phila. 1862, p. 391; Cabot, p. 3, No. 4, pl. 2, fig. 4.

One male nympha skin from Rock Island, Illinois, by Mr. B. Walsh; one male skin and one female, just emerging, from Hannibal, Ill., transforming in numbers May 27, 1872, by Mr. Charles V. Riley. Length 31 mm. The nympha was compared formerly with *G. vulgatissimus*, but it is nearer to the group of *G. notatus*, the nymphæ of which were not known at the time.

Body somewhat stout, little hairy; head cordate, less notched, angles globular; third joint of antennæ twice the length of the two basal, cylindrical, bent up,

flattened above, and a little dilated, tip truncate; fourth joint rudimentary, a small tubercle; mask oblong, one-third longer than broad, channeled below, sides bent up, base narrowed; middle third of front border straight, with longer comb of flat scales; palpus just meeting, strong, dilated, very arcuate, dentated to base, end hook long, sharp; movable hook long, bent, sharp; wing cases reaching 4th segment; abdomen stouter, less spindle shaped, more rounded above than below, a little more than thrice longer than broad, the last four segments tapering; 9th scarcely longer than 8th, half as broad on tip; last segment one-third of 9th; lateral spines on 6th to 9th, the last as long as 10th segment; dorsal hooks on 8th to 9th, short tubercles: scars as usual, genitals marked; appendages nearly twice the length of 10th; triangular, less sharp, laterals one-third shorter; legs stout, for burrowing, hind legs longer, exceeding 7th segment; third joint of posterior tarsi as long as the two basal.

Mr. Walsh stated the nympha would belong to one of four species,—*G. notatus*, *annicola*, *vastus*, *fraternus*. The nympha of *G. notatus* is now known, and I received these skins with the imago male and female of *G. vastus* raised by Mr. Charles V. Riley.

21. **Gomphus pallidus** (raised).

Rambur.—Selys 4th Addit. Synops. Gomphin. p. 52. No. 1; Cabot, Mon. p. 2, No. 2, pl. i, fig. 3 (*G. pilipes*).

One nympha skin, female, together with the just emerged imago from Peoria, Ill., June, 1878, by Prof. A. S. Forbes; two nymphæ in alcohol from Charleston, S. C., the types of Mr. Cabot; one from Detroit, Mich., June 6, 1879, by Mr. H. G. Hubbard; four young ones from Waltham, Mass., by Mr. S. Henshaw; a female nympha skin from Dallas, Texas, in McLachlan's collection. Length 35 to 39 mm.; breadth 10 mm.

Body lancet shaped, very elongate, flat, without hairs except on limbs; head cordate, flat, eyes large; vertex transverse-oblong, ocelli well marked; on each side near the vertex a crescent furrow ending on the front angle of eye; two basal joints of antenna globular, second smaller, third nearly twice as long as the two basal ones, as thick as second, cylindrical, bent up a little, truncate on tip; fourth rudimentary, a small rounded tubercle; antennæ and anterior border of head very villous; occiput short, villous behind, very little notched behind in the middle, and with another notch on each side near the hind angles, which are semi-globular with some polished scar-like spots; mask reaching forelegs, small, oblong, one-half longer than broad, basal third a little narrowed; sides straight, bent up; middle third of front margin produced in a short rounded lobe with comb of flat scales and a prominent black tooth in middle; palpus short, just meeting, end hook rounded externally, sharp, not longer than the six or seven teeth between them and the base; movable hook long, bent, sharp; prothorax narrower than head, half as long as broad, hind part with three rounded tubercles in the middle and a larger one near the sides, somewhat pointed outwards; wing cases covering a little 4th segment; abdomen very flat, nearly thrice longer than broad, narrowing after segment 4, sloping to the more contracted segments 9 and 10; segment 9 longer than 8, its apex half as broad as its base; 10th cylindrical, half as long as 9th, only 2 mm. broad; lateral spines very short on 7th and 8th, very long,

straight, three-quarters as long as last segment on 9th; no dorsal hooks, but on 3 to 9 along the median line of segments a flattened pad covered with fine felt, ending on 9th (and much smaller on 8th) in a short, flat, triangular median spine exceeding the apical margin of the segment; scars on 3 to 8 with a black maculose streak and three black and polished spots; on 9th and less visible on 10th a longitudinal blackish line not reaching base or apex: on 3 to 8 two black transversal dots in the middle of segments: appendages less than half of last segment, pyramidal, sharp on tip, of equal length: laterals a little shorter; the genitals marked: the ventral longitudinal sutures straight, nearer together on 9th, ending on the lateral spines: lateral spaces as broad as the middle one; legs short, strong, fringed with long hairs; first legs a little shorter than second, curvate, a strong apical end hook on tibia, claws short, strong, third pair longer, the more flattened femur reaching 4th segment, claws a little longer: third joint of tarsi nearly as long as the two basals together; lateral margin of abdomen villous.

The smaller nympha 25 mm. long from South Carolina, collected by Osten Sacken and mentioned by Mr. Cabot, p. 2, has the apical spine on segments 8 and 9, and would well belong to *G. pallidus*, were not the lateral spines on 9 very short.

Prof. Forbes has dredged in Cedar Lake, Illinois, Oct. 16-18, 1882, in very shallow water and caught a number of very young nymphæ which belong surely to *G. pallidus*; length 8 to 20 mm.; more villous than the full grown; shape of body the same but flatter; occiput nearly straight behind, antennæ with fourth joint larger, more globular; middle tooth on front margin of mask visible; palpus inside with five to eight teeth; wing cases only reaching 2d segment; abdomen sloping gently to tip; 9th segment longer than 8th, the middle spine on apical margin visible; lateral spines on 7th to 9th segment, the latter ones half as long as 10th segment.

The principal characters for *G. pallidus* are the middle tooth in front margin of mask, which becomes blackish in the full grown; the teeth along the whole inner margin of palpus; the sloping of the abdomen is continuous and not suddenly stronger after 7th segment; the middle dorsal spine on apical margin of 9th; lateral spines only on 7 to 9, the latter one longer; even the youngest nymphæ, 8 mm. long, shows those characters, though the wing cases are justly budding and do not reach the end of segment 1; the teeth on the palpus are less in number, the lateral spines shorter.

The nymphæ represent four different moults; those long 8 to 12 mm. have six teeth on the palpus farther distant and more pointed; those 15 to 25 mm. long have seven teeth near together, but straight on tip and the inner angles sharper and rejected; the apex of the teeth somewhat notched; those long 27 mm. with eight teeth, more pointed; the full

grown nymph skins have the teeth longer, sharply pointed, divergent, the last longest; genitals marked in the nymphæ 15 mm. long and longer.

22. **Gomphus** spec.

One female nymph skin from the Tapajos River, Amazon, Thayer expedition. Length 35 mm.

Body large, stout, hairy; head cordate, about as broad as long, hind angles globular, between them two smaller tubercles; antennæ short, third joint less than thrice the length of the basal, somewhat dilated in middle, flat above, tip bent up; fourth very small, cylindrical; mask large, oblong, one-third longer than broad, sides somewhat convex, basal third a little narrowed, middle third of front border produced in a short rounded lobe with pavement teeth and a comb of flat scales; palpus strong, short, not meeting, arcuate, with a few molar incisions; end hook long, very much bent, sharp; movable hook long, bent, sharp; wing cases reaching 5th segment; abdomen stout, rounded above, one and a half longer than broad, the last three segments slowly tapering; segments of equal length, 10th conical, a little longer than 9th; lateral spines on 5 to 9, very small on 5, the other longer, very strong, divergent from the segments; dorsal hooks on 2 to 9 very strong, the last pointed; scars as usual; genitals very little marked; inferior appendage thin, sharp, as long as segment 10; laterals similar, but one-third shorter, the other wanting; legs short, strong, adapted for burrowing; hind legs flat, reaching 7th segment; third joint of posterior tarsi as long as the two basal.

A nymph skin long 24 mm. from the same locality belongs probably to a previous stage of the same species; the only differences are that the rounded middle part of the mask is more produced, nearly semi-circular; the palpus is larger, inner margin without molar incisions and convex, end hook longer, bent suddenly down at the base and the tip bent again in the opposite direction. The only skin is in bad condition, therefore the differences may be considered as accidental ones until more specimens will warrant a new species.

The species belonging to the nymph is probably not yet known.

23. **Gomphus** spec.

One nymph in alcohol from Carundaby River, Brazil, Thayer expedition. Length 22 mm.

The nymph is very much alike to those from the Tapajos River, but differs as follows: wing cases reaching third segment (the nymph is apparently younger); lateral spines on segments 7 to 9; appendages as long as last segment, very sharp, the superior and the laterals of equal length, very little shorter than the inferiors; hind legs longer, reaching about 9th segment.

I would not have separated this nymphæ except for the unusual length of the lateral appendages and the smaller number of lateral spines.

Group of **G. plagiatus** (raised).

Body very elongate; head as broad as abdomen; third joint of antennæ twice the length of the two basal, flat; fourth rudimentary, a small tubercle; mask oblong, little longer than broad, little narrower at base, middle third of front border straight (very little rounded in *G. olivaceus*); palpus with a strong end hook and a few sharp teeth just before it; abdomen spindle shaped, four to five times longer than broad, about rounded, segment 9 longer than 8, to twice its length; 10th very short, lateral spines on 6 to 9; dorsal hooks none, except a flat, small, triangular apical spine on 9; apical hook on the four anterior tibiæ very small; ventral bags on segments 4 to 6.

*G. plagiatus*, *notatus*, *spiniceps*, *olivaceus*? form a type rather different of all other Gomphus by the long spindle-shaped abdomen, not broader than the head, the length of segment 9 and the rudimentary hooks of the anterior tibiæ. *G. olivaceus*? is somewhat different, perhaps not belonging here. Of the other species *G. vastus* is similar, but the hooks of the tibia are very strongly developed. Probably other species will belong to the group of *G. plagiatus*. The very abnormal form of the abdomen indicates, perhaps, a higher group than a sub-genus.

24. **Gomphus plagiatus** (raised).

Selys Monogr. Gomphin. p. 159.

Two nymph skins, male and female, from Crescent City, Fla.; a male nymph in alcohol, the imago, half out, from Dandridge Junction, Tenn. Length 40 mm.

Body very elongate, little hairy; head cordate, deeply notched behind; eyes large, prominent, hind angles globular, rounded; antennæ short, third joint twice the length of the two basal, cylindrical, a little thinner than second, bent up, fourth rudimentary, a rounded knob; mask oblong, one-third longer than broad, channeled below; sides bent up, oblique; basal third a little narrowed; middle third of front border nearly straight, with a very short comb of flat scales; palpus short, strong, arcuate, with a strongly bent sharp end hook, and three molars just before it; movable hook long, bent, sharp; wing cases reaching nearly 4th segment; abdomen five times longer than broad, spindle shaped, as broad as head, very slowly tapering; rounded above, less below, where the middle part between the longitudinal sutures is broader than the lateral parts; segments of equal length, 9th not fully twice as long as 8, tip half as broad as base, 10th very short, cylindrical, as long as broad; lateral spines on segments 6 to 9, sharp, long, on 9th half longer than 10th segment; dorsal hooks none, except on 9th a flat, apical, triangular spine as long as segment 10; scars as usual; genitals marked; ventral segments 2 to 8 with a round elevation for the ganglia; appendages as long as segment 10, triangular, sharp, laterals very little shorter; legs comparatively small, the anteriors burrowing legs; hind legs short, reaching end of segment 5; third joint of posterior tarsi about as long as the two basal, first joint much shorter than second.

25. **Gomphus notatus** (*fluvialis* Walsh) raised.

Selys Monogr. Gomphin. p. 159.

One male nymph skin from Detroit, Mich., raised by Mr. H. G. Hubbard; eight in alcohol half to full grown from Cairo, Ill. July 26, and Pekin, Ill., October 9, by Prof. A. S. Forbes; one female nymph skin from Crampton, Mass., by F. G. Sanborn. Length 25 to 35 mm.

Similar to *G. plagiatus*; head cordate, strongly notched behind, angles globular; ocelli visible; third joint of antennæ twice the length of the two basal, cylindrical, flattened above, bent up; fourth rudimentary, a small tubercle; mask oblong, one-third longer than broad, channeled below on apical half; sides bent up; basal third a little narrowed; middle third of front border nearly straight, with a very short comb of flat scales; palpus short, strong arcuate, with a strongly bent sharp end hook and three quadrangular teeth just before it; movable hook long, bent, sharp; wing cases covering half of 4th segment; abdomen nearly four times longer than broad, spindle shaped, as broad as the head, tapering, rounded above, less below; segments of equal length, 9th about one-third longer than 8th, conical; segment 10 very short, cylindrical, half as long as broad; lateral spines on 6 to 9, the last one as long as 10th, triangular, blunt at tip; dorsal hooks none; a flat, apical, triangular spine on 9th not exceeding the apical margin of the same segment; scars as usual; genitals marked; appendages a little longer than last segment, triangular, not very sharp, laterals very little shorter; legs short, hind legs longer, exceeding 6th segment; third joint of tarsi about as long as the two basal, first nearly as long as second; antennæ and legs very hairy.

The specimen from Massachusetts is very similar, but somewhat stouter, abdomen larger, less rounded, segment 9th hardly longer than 8th, its apical dorsal spine only indicated; lateral spine less than half the length of 10th. If it should belong to another species, I do not know to which; at least the imago could not be smaller than *G. fluvialis*.

26. **Gomphus spiniceps** (raised).

Walsh Proc. Acad. N. Sci. Phila. 1862, p. 889; Cabot, p. 5, No. 8, pl. ii, fig. 1.

Two nymph skins, male and female, taken in transformation, the male half out of the skin, at Lawrence, Mass., July 4, 1867, by Mr. F. G. Sanborn. Length 41 mm.

Body very elongate, very narrow, little hairy; head large, cordate, as broad as abdomen, about straight behind, angles blunt, with broad but low tubercles, third joint of antennæ twice as long as the two basal, very little larger on tip, bent, somewhat flattened above; fourth rudimentary, a short tubercle; mask large, a little longer than broad, channeled below, sides bent up, a little narrowed at base, middle third of front border straight, with a short comb of flat scales; palpus short, strong, very arcuate, end hook strong, bent, sharp; just before it two strong teeth; wing cases reaching nearly 4th segment; abdomen spindle shaped, slender, more than four times longer than broad, very slowly tapering after 4th segment, strongly convex above, a little less below; segments of equal length, 9th twice the length (6 mm.) of 8th, a little narrowed in middle, 10th very short (1 mm.) cylindrical; lateral spines on 6 to 9 short, not sharp, the last one-half as long as 10th, no dorsal hooks except a very short, flat, triangular, apical spine on 9th;

scars as usual, on 9th long, linear; genitals marked; appendages as long as 10th segment, short, cylindrical, not very sharp, the laterals scarcely shorter; legs short, strong, for burrowing; hind legs a little longer, reaching about end of 5th segment; third joint of posterior tarsi as long as the second; apical hook on anterior tibiæ very small; femur with a strong apical hook internally.

*G. spiniceps* is very similar to *G. plagiatus*, but the legs are shorter and stronger, the abdomen more slender and slower tapering, lateral spines shorter. The hook on anterior tibia in *G. plagiatus*, *notatus*, *olivaceus*? is as small as in *G. spiniceps*.

27. **Gomphus olivaceus?** (supposition.)

Selys Syn. Gomphines iii, p. 21, quart.

One male nymph skin in alcohol from Great Salt Lake, Utah, by Mr. Garman. Length 32 mm.

Very similar to *G. notatus*; body somewhat hairy, third joint of antennæ wanting; mask more oblong, basal third narrower; front border in middle third produced in a short rounded lobe, with a very short comb of flat scales; palpus similar to *G. notatus*; abdomen a little broader, more lancet shaped; segment 9 a little longer than 8, with a very short apical spine above; lateral spines on 6 to 9, the last one blunt, half as long as segment 10, which is very short, cylindrical; scars as usual; the rectum with part of the intestinal apparatus retained in the skin; ventral pockets in segments 3 to 5 small, triangular; appendages similar, rather blunt; legs similar.

The rounded middle lobe of the mask, the somewhat broader abdomen, the shorter lateral spine on segment 9 are the principal differences. It seems probable that this nymph belongs to *G. olivaceus*.

Sub-genus CYCLOGOMPHUS? (supposition.)

Selys Monogr. Gomphin. p. 105.

Body flat, similar to *G. vulgatissimus*, third joint of antennæ twice the length of the two basal, hardly thicker, flat, bent up; fourth very small, conical; mask one-third longer than broad, sides oblique, base one-third narrower than front; the middle third of front border produced in an elliptical lobe with a deep rectangular cleft; abdomen flat, lancet shaped, segments of equal length, 10th half as long; lateral spines on 5 and 9; no dorsal hooks; legs more slender, less fit for burrowing; hooks on the four anterior tibiæ rudimentary, nearly wanting.

The cleft of the lobe of the mask is entirely abnormal; the lack of developed hooks on the tibiæ is also abnormal. Both characters together seem to indicate for this species a rather higher position than a sub-genus. That the species belongs to *Cyclogomphus* is only a supposition.

28. **? Cyclogomphus** species.

Cabot p. 5, No. 7, pl. ii, fig. 2.

Seven nymph in alcohol, probably not full grown, some younger; from Ghugger Pir, Himalaya, by Rev. M. M. Carleton. Length 23 to 17 mm.

Body flat, elongate, not very hairy; head cordate, little notched behind, angles blunt, oblique; antennæ short, third joint about twice the length of the basal ones, hardly thicker, flat, bent up, smaller on tip, fourth very small, conical, black; mask one-third longer than broad, deeply channeled below, sides sloping to base, which is one-third narrower than front; middle third produced in an elliptical lobe, half as long as broad, with a deep rectangular cleft, and with a comb of flat scales, except in the cleft; palpus a strongly bent sharp hook, with a few molar incisions; movable hook long, sharp, bent; wing cases reaching 4th segment; abdomen flat, lancet shaped, tapering gradually, dorsum slightly rounded; segments of equal length, the last half as long; segments 5 to 9 with sharp lateral hook spines, the last one-third of segment 10; no dorsal hook; sears as usual, light brown; female genitals marked by two small darker spots; appendages a little longer than 10th segment, pyramidal, not very sharp, the laterals one-third shorter, the middle one in some males with two tubercles before tip; legs longer, more slender, hind legs reaching 7th segment, third joint of posterior tarsus about as long as second; hooks on anterior tibiæ rudimentary nearly wanting.

The largest of the nymphæ shows that a change of skin is imminent, though the female genitals begin to be marked they are all apparently not full grown. The principal character is the largely notched lobe of the mask. I have (Cabot, p. 16) advanced the supposition that the nymphæ may belong to *Cyclogomphus*, which is, nevertheless, uncertain, except for geographical reasons.

Sub-genus ? *EPIGOMPHUS* (supposition).

Selys Monogr. Gomphin. p. 84.

Body more elongate, *Aeschna* like, third joint of antennæ more than three times longer than the two basal, straight, little dilated, fourth very short, ovoid; mask small, once longer than broad, sides oblique, base nearly half as broad as front border, the middle third of which produced in a round lobe with two teeth; abdomen four times longer than broad, flat, very gradually narrowing to tip, segments of equal length, 10th even a little longer than 9th; lateral spines on 7 to 9, dorsal hooks on 3 to 9.

The very unusual length of the last segment, the length of the third joint of antennæ and the unusual occurrence of two somewhat prominent teeth near the middle of the rounded lobe of the mask, which is also longer and narrower than in any other species seem to indicate for this species a higher position than a sub-genus. That the species belongs to *Epigomphus* is still a supposition, but a rather probable one.

29. ***Epigomphus ? paludosus ?*** (supposition).

Cabot, p. 1, No. 1, pl. 1, fig. 2.

A full grown nymph (Cabot's type) from Rio Macaros, Brazil, Thayer expedition. Length 34 mm.

Body *Aeschna* like, elongate, hairy; head cordate, hind angles globular, between them two smaller tubercles; third joint of antennæ more than thrice the length



of the two basal, straight, a little dilated, bent up at tip; fourth joint very short, ovoid; mask small, once longer than broad, sides oblique, bent up, front border less than twice the breadth of base, middle third produced in a rounded lobe, edged with pavement teeth and two small, black, longer teeth in the middle and with a comb of flat scales; palpus small, scarcely meeting, end hook sharp, strong, arcuate, longer than the nearly straight margin, which is provided with ten teeth; movable hook long, sharp, arcuate; wing cases reaching 4th segment; abdomen elongate, four times longer than broad, very gradually narrowing to tip, somewhat rounded above, flatter below (the figure is too broad at the base); segments of equal length, 10th very little longer than 9th, cylindrical, narrower at tip; dorsal hooks on segments 3 to 9, thicker on segment 3, nearly obliterated (accidentally?) on 6, longer and sharper on 7 to 9; lateral spines on 7 to 9; scars as usual, genitals not marked; appendages long, sharp, pyramidal, inferiors as long as segment 10, middle one a little shorter, basal half thickened above, laterals one-third shorter than the inferiors; legs short, strong, formed for burrowing; hind legs longer, flatter, reaching 7th segment; third joint of posterior tarsi as long as the two basal, which are of equal length.

There is from the same collection a very young larva, length 15 mm., the wing cases only marked; antennæ and mask similar; abdomen much more hairy, less elongate, more suddenly tapering, lateral spines on segments 8 to 9; dorsal hooks just visible; appendages similar; legs longer, more hairy. There is no doubt that the larva belongs to the same species.

The nympha was formerly supposed to belong to *Herpetogomphus*, as then this genus contained the only known species from Brazil. The discovery of the nymphæ of *Herpetogomphus*, one raised, and the discovery of several species in Brazil representing different forms, proves that the nympha does not belong to *Herpetogomphus*, but perhaps to some of the newly discovered species.

Among the four *Gomphus* known from Brazil the elongate form of the nympha would agree best to *E. paludosus*.

## II LEGIO GOMPHOIDES.

Selys Monogr. Gomphin. p. 189.

Of the four genera belonging to the Legio Gomphoides all are known except *Zonophora*. The three known genera belong to entirely different types, and perhaps it will be more natural to drop entirely this Legio, the more so as the imagos form also a motley crowd, and so dissolve it in three co-ordinate groups.

*Progomphus*, with its *Aeschna* like body, the middle legs less distinct than the forelegs, and the ventral sutures ending on 8th segment is very different from all other Gomphina; the prothorax-stigma is covered.

*Gomphoides* with its slender spindle-shaped abdomen, the unusual length of the much more slender 10th segment, and the small mask is also unique among Gomphina; the prothorax-stigma is free.

*Hagenius* with its very flat and large circular abdomen, with the unusual large, flat, circular third joint of antennæ and the very long legs can scarcely be united with the other ones; the prothorax-stigma is free.

Finally, the two abnormal nymphæ from Kentucky and Japan are out of question till the imago is known.

In fossil layers the insects of the sub-family Gomphina belong to the oldest Odonata; among them the Legio Gomphina is the last to appear. Probably what we know now of the Legio Gomphoides, represents only isolated remnants of genera in former times largely developed. The links are lost, or not yet known.

Genus *PROGOMPHUS* (supposed).

Selys Monogr. Gomphin. p. 194.

The nymphæ of *Progomphus* differ by some striking characters from all other belonging to the Legio Gomphoides. The head is large, flat, square, as large as the bulky thorax and the abdomen; the fourth joint of antennæ is about one-fourth as long as the third; the small but more elongated mask is produced on the front border in a rounded large lobe; the flat scales of the comb somewhat distant from each other; abdomen tapering slowly from the base, less rounded above, with dorsal hooks on segments 1 to 9; lateral spines from 5 to 9, or 3 to 9; last segment conical, free; appendages sharp, the laterals very short; abdomen below flat, the two longitudinal sutures ending on each side on the apical angle of segment 8th (instead of 9th, as in all other species); the middle legs nearer together at base than the forelegs; the legs are very strong burrowing legs, short and thick; the tarsi knife shaped. The position of the middle legs and the ventral sutures are alone sufficient to separate the nymphæ from all related ones, especially from *Onychogomphus*. The covered stigma of the prothorax is similar to *Gomphus* and separates *Progomphus* from the other genera of the Legio Gomphoides.

30. ***Progomphus obscurus*** (supposition).

Selys Monogr. Gomphin. p. 201; Cabot, p. 6, pl. ii, fig. 3.

Three nymphæ in alcohol, male and female, probably full grown, from Wareham, Mass., May, 1863, by Prof. L. Agassiz; one in alcohol from Little Wabash River, Effingham, Ill., June, 1878, Prof. S. A. Forbes. Length 27 to 30 mm.; breadth 6 mm.

Stout, hairy, *Aeschna* like: head large, as broad as abdomen, flat, cordate, notched behind, angles globular: antennæ stout, third joint very hairy, long, dilated, more than twice the length of the two very short basal, fourth joint short,

thin, conical, strongly recurved, about one-fourth the length of the third joint; mask extending to forelegs, narrow, oblong, half as broad, somewhat enlarged at front border, the middle third produced in a semi-circular lobe, with a long comb of flat scales; palpus just reaching, nearly straight, rounded on tip, smooth inside; movable hook short, bent, sharp; prothorax nearly as broad as head, large, transverse-oval; wing cases exceeding a little segment 4th; abdomen *Aeschna* like, three times as long as broad, flattened below, rounded above, tapering from 5th segment; segments of about equal length, the two basal a little shorter, 9th a little longer; dorsal hooks on segments 1 to 9, the three basal very strong, the following much smaller; lateral spines on 5 to 9; scars as usual, encircled behind by a brown border; base of segments on each side with two triangular brownish spots; longitudinal ventral sutures ending at the apex of 8th segment, the middle space a little longer; segments 2 to 8 on each side with a brown crescent band; appendages longer than 10th segment, triangular, very sharp, laterals less than half shorter; legs stout, very strong, hairy, typical burrowing legs; tibiae thick after base, bent up at tip, without apical hook; middle legs nearer at base than forelegs, hind legs nearer at base than forelegs, hind legs widely separated, reaching nearly 8th segment, third joint of tarsi longer than the two basal, claws long, sharp; the claws of four anterior legs blunt.

As *P. obscurus* has now been collected near Boston, by Mr. Morrison, there can be scarcely a doubt, that the nymphæ belong to this species.

31. **Progomphus** spec.

Cabot, p. 7 (note at the end).

A female nympha from Carundahy, Brazil (Cabot's type), a nympha from Rio dos Macacos, Brazil, four nymphæ from Rio Negro, Amazon, two young, all in alcohol, from Thayer expedition. Length 20 to 25 mm.

The later discovery of the other nymphæ from Brazil proves that there has been no mistake in the label, as was supposed, when Mr. Cabot published the monograph of Gomphina. Nevertheless, even to-day with so much more material before me I am at loss to find structural differences. The nymphæ from Brazil are indeed less bulky and more slender and the lateral appendages rather shorter, only one-third of the laterals; until now *P. obscurus* has not been found in Brazil, and it seems probably that these nymphæ belong to a different species.

32. **Progomphus** spec.

Six nymphæ in alcohol young and some probably full grown from Santiago, Cal., by Mr. G. R. Crotch, 1872. Length 20 to 27 mm.; breadth 7 mm.

These nymphæ are so similar to *P. obscurus*, that it is difficult to separate them; but all have lateral spines on segments 3 to 9 instead on 5 to 9. The black spots above on abdomen are larger; the ventral segments 6 to 10 have transversal basal black bands, enlarged to the lateral margins; the abdomen a little broader.

Perhaps the nymphæ belong to *P. zonatus*, or to *P. meridionalis*, n. sp. from Arizona, as a similar nympha 24 mm. long was collected by R. Crotch, San Diego, Cal.

Genus GOMPHOIDES (raised).

Selys Monogr. Gomphin. p. 206.

The principal character of the nymphæ of Gomphoides is the unusual length, one-third to nearly one-half of the abdomen, and lankness of the 10th segment. As far as yet known this character is unique among all Odonata. The very slender spindle shaped abdomen, about three-quarters of the whole body has the ventral sutures ending on the apical angles of 9th segment; anal appendages very short, of equal length; the four anterior legs equally distant.

There are two different groups represented; one (*Cyclophylla?*) has the front border of the narrower mask produced in a large rounded lobe with a long dense comb of scales and the palpus as a short, thin, sharp hook; lateral spines on 7 to 9. The other (*Aphylla?*) has the front border of the larger mask produced in a very short rounded lobe with a very short and wide comb of bent up pointed scales; lateral spines rudimentary and only on 9th segment. The mask of both reaches half way between fore- and middle legs; prothorax stigma free.

Of the thirty-two known species only three nymphæ are known; one of them just casting the skin proves that the nymphæ belong to this genus.

33. **Gomphoides** spec. (raised).

Cabot, Gomph. p. 8, No. 10, pl. j, fig. 5.

One male nympha, just beginning to transform in alcohol, from Santa Cruz, Brazil, Thayer expedition. Length 37 mm.; breadth 6 mm.

Body long, slender; little hairy; head large, about as broad as the thorax, cordate, notched behind; eyes large and prominent; ocelli well developed; antennæ short, inserted in a kind of trumpet-like inflation on each side of the inferior ocellus; the two basal joints globular, third twice as long, strong, dilated, bent up a little, with long and dense hairs, fourth very short, linear, recurved; mask reaching half way between fore- and middle legs; breadth half the length, enlarged in front, the middle produced in a large rounded lobe, with a long comb of dense, flat scales; palpus a short, thin, sharp hook; movable hook similar but longer; wing cases reaching middle of 4th segment; abdomen long, spindle shaped, venter less rounded than dorsum, tapering slowly to end of 9th segment; segments of about equal length; 10th very long, nearly one-third of abdomen, very thin, nearly cylindrical; short lateral spines on 7 to 9; dorsal hooks on 2 to 7, strongest on 3d, short but sharp on the following, only indicated on 8 to 9; scars as usual; genitals indicated; ventral sutures ending on the apical angles of seg-

ment 9, middle space a little larger; anal appendages very short, pyramidal, sharp, all of equal length; legs short, very hairy; the four anteriors about equally distant, hind legs more separated; femora arcuated, tibiæ straight, longer, second joint of tarsi knife shaped, claws very short, blunt; hind legs more slender, longer, reaching 6th segment, third joint of tarsi as long as the two basal, claws longer, pointed.

The only specimen is beginning transformation; head and thorax are split as usual, but not yet taken out, only the base of the wings is beginning to show outside the wing cases. In lifting a little the skin of the thorax it is to be seen that the thorax of the imago before the wings is blackish, perhaps dark greenish, on each side with a pale divergent band. In fact the parts are similar to those of several Gomphoides. It was stated that perhaps the nympha may belong to *Aphylla brevipes*, which species has segment 10th as long as segment 9th, but this supposition is rather improbable, since the nympha supposed to belong to *A. producta* was discovered I think it may belong to *Cyclophylla*. The abdomen of the imago still in the abdomen of the nympha is pale with two dorsal longitudinal blackish bands.

34. **Gomphoides** spec.

Cabot, Gomph. p. 9, No. 11.

Three female nymphæ in alcohol from Rio dos Macacos, Brazil, Thayer expedition. Length 31 to 35 mm.

Not full grown; very similar to the specimen from Santa Cruz; differs by the fourth joint of antennæ stronger and longer; by the want of the trumpet-like inflation for the insertion of antennæ; by well developed dorsal hooks on 2 to 9; the dorsal hook on segment 2 is a tubercle (just as in the other species), the third strongest, all the other nearly equally developed.

In comparing the two species perhaps some allowance is to be made for the fact that the first species is just transforming. Perhaps the shorter fourth joint of antennæ and even the trumpet-like inflation may be the consequence of the extraction of the antennæ of the imago, for the seta is to be seen in the third joint of the nymphæ. But as the dorsal hooks are sharp, short, horny spines, they cannot disappear during transformation. Therefore the three younger nymphæ seem to belong to a different species.

35. **Aphylla producta** (supposition).

Selys Monogr. Gomphin. p. 230.<sup>1</sup>

Two nymphæ skins, male and female, from Crescent City, Fla. Length 58 mm.; breadth 8 mm.

Body slender, very elongate, very little hairy; head large, about as broad as the body, cordate, deeply notched behind, eyes very large, globular behind: a polished elongate spot before each of the posterior ocelli, four polished round spots on occiput, the two interiors smaller: antennæ inserted in a trumpet-shaped inflation,

which is nevertheless depressed except on tip; the two basal globular, third joint less than thrice as long, cylindrical, bent up, scarcely thicker on tip, hairy below; fourth very small, short, linear; mask reaching half way between fore- and middle legs, large, one-third longer than broad, narrowed to base, a little more in basal third, channeled below, sides bent up; middle third of front border produced in a small short rounded lobe, with a short comb of bent up, pointed, more distant scales: palpus short, broad, with slender bent down end hook and four teeth before nearly as long and as strong as the end hook; movable hook long, arcuate, sharp; wing cases reaching end of third segment, margins with long hairs: abdomen very long (45 mm.), spindle shaped, tapering slowly to end of 9th segment; venter less rounded, lateral margin thickened; segments of nearly equal length, 9th a little shorter; 10th very long (18 mm.), not full half the length of abdomen, very thin (1.5 mm.), cylindrical; lateral edge of segments 7 to 9 below with a thin fringe of long hair, lateral spines only on segment 9, very short and blunt; sharp dorsal hooks on 2 and 3, on 4 to 9 a broad apical rounded tubercle, sometimes with a very small short spine; scars with several spots and a superior, short, oblique, snow-white band; genitals marked; ventral sutures ending on the apical angles of 9th segment: middle space nearly twice as large as the laterals: anal appendages very short, about as long as segment 10 is broad, of equal length; laterals black, very sharp, apical half narrower, the three other blunt, pale, membranaceous, the basal half of the middle appendage of male above thickened, triangular and horny black as the laterals; legs short, moderately strong, hairy, four anteriors equally distant, hind legs more separated: four anteriors burrowing legs, claws short, sharp, arcuate, hind legs longer, more slender, reaching 6th segment, third joint of tarsi as long as the two basal; claws sharp, long, less arcuate.

*Aphylla producta* is not yet recorded from Florida, but as it is very common in Cuba, the supposition is very probable, if the nymphæ belong at all to a known species.

Genus **Hagenius** (raised).

Selys Monogr. Gomphines p. 238.

The prominent characters of the nymphæ are the broad, short, circular, very flat abdomen, the flat, large, circular third joint of antennæ, which is cut straight internally and therefore very approximate to the opposite one, the large, flat, running legs, the hind ones much longer than the abdomen, and the middle legs more separated at base than the forelegs; prothorax stigma free. The nymphæ of *H. brevistylus* and *japonicus* look so different from all nymphæ of Odonata, that there is no mistake possible; to a certain manner they are mimicked by *Macromia*. The distance of the legs, the ventral sutures of abdomen, and the lateral suture, which is entirely ventral and separated from margin to a considerable extent, exclude the nymphæ of *Hagenius* from *Gomphus*.

The supposed nymphæ of *H. ? nanus* is apparently related to *Hagenius*, but differs by the elongate third joint of antennæ, mask and palpus, the

more oblong abdomen, the shortness of legs, which are real burrowing legs with a strong apical hook of tibiæ, wanting by Hagenius.

The nymphæ from Kentucky have antennæ of Hagenius, mask and palpus of *H. nanus*, legs of the same, but the distance of the two anterior pairs equal, abdomen of *Gomphus* with ventral sutures and last segment of *H. nanus*. The discovery of the imago is very desirable, to fix the position of the nymphæ.

36. **Hagenius brevistylus** (raised).

Selys Monogr. Gomphin. p. 241; Cabot p. 9, No. 12, pl. iii, fig. 4.

I have seen a large number of nymphæ, very young till full grown, dry or in alcohol, and several nymphæ skins. A dozen is still before me from Orono, Me., Massachusetts, New York, Kentucky, Kansas, male and female. The species was raised by T. W. Harris; one nymphæ with the imago half out was presented to the collection by Prof. Fernald; similar ones by other students. Length 12 to 40 mm.

Body very flat, about circular, not hairy; head large, flat, cordate, as broad as long; between the antennæ a narrow projection, with rectangular notch on tip and sharp angles, inserted in which is a cordate tubercle: eyes a little before the hind part of head, moderately large, rather conical; side part of head below and before the front angle of the eyes protracted near the mouth in a triangular lobe; vertex flat, ocelli visible, small, near each of the hind ones a larger elongate flat spot, and two smaller ones before the anterior ocellus; occiput short, but large, separated from the forehead by a suture uniting the sharp inner angles of the eyes and the well marked posterior margin of eyes; hind border of occiput straight, a little notched in middle, median suture well marked, on each side a small conical tubercle; lateral hind angles pyramidal, strongly elevated; antennæ short, the two basal joints cylindrical, first once broader than long, the second merely annular; third joint a large flat disc, circular, three times broader than the first, the inner edge cut straight, border somewhat elevated; fourth joint rudimentary, represented by a very small black spine in the swollen anterior border of third not far from the apical angle; the third joint is covered, less below, with short flat scales, longer on the inner border; similar scales cover the basal joints, more or less the head, occiput and prothorax; mask square, sides bent up, base a little narrowed; front border slightly convex, middle third a little more produced, with pavement teeth: above with a short but thick comb of flat scales; palpus short, a flat broad lobe, rounded on tip, finely serrated within: movable hook longer, arcuate, sharp; prothorax narrower than head, excavated, more than twice as broad as long, straight before, a little rounded behind, sides bent up; a transversal suture separates the front part; wing cases reaching 6th segment; abdomen very large, exceedingly flat (4 mm. high by 25 mm. long), more than twice broader than head, nearly circular on young and half grown specimens, a little longer than broad (23 mm. long; 20 mm. broad) on full grown: the first three segments tapering to base, the three last to tip; segments 1 and 2 very short, 3 to 9 nearly equal (2.5 mm. long; 20 mm. broad), 10th very short, inserted entirely in a quadrangular excision of 9th; the outer edges of segments 2 to 9, which are in fact the lateral spines, form a sharp-edged border, separated from the abdomen by a ven-

tral suture; the posterior border of the edges is oblique, but on segments 6 to 8 with a rounded lobe before tip; on 9th the edges are as long as segment 10 and close to it: the segment 10 on each side with a short, blunt, apical protraction; dorsal hooks on segments 2 to 10, but varying much in size and elevation; on the last 2 to 4 segments they are often represented by a more or less strong median ridge, though the basal segments have mostly very strong hooks; scars in the middle of segments, the dorsal part between the scars lancet shaped and slowly higher towards the middle (about 4 mm.), the marginal part of the abdomen outside the scars about 1 mm. thick; venter flat: the two longitudinal sutures parallel, divergent on segments 2 and 9, ending externally of the apical angles of 9th: middle space about half as broad as the laterals: stigmata near the middle of base of lateral spaces on 2 to 8 are very small, but larger on 8th; ventral bags triangular, on base of segments 4 to 6 somewhat externally of the stigma; genitals marked; the whole margin around the abdomen edged with a fringe of scales; anal appendages short, stout, pyramidal, blunt, a little longer than 10th segment, superior somewhat shorter, channeled at sides, lateral very small, half as long as the others; legs long, flat, slender, formed for running; legs widely distant, middle ones more separated at base than forelegs; a sharp, elevated, transversal ridge on each side with a strong spine on the prosternum and the mesosternum, and a triangular hook on the under side of the coxa of the four anterior legs; forelegs shortest, edged with flat scales, femora flattened. tibiæ angular, longer than femora, tarsi less than half as long as tibiæ: middle legs a little longer than forelegs: hind legs very long, much longer than abdomen, femora reaching 7th segment: tibiæ a little shorter: tarsi half as long as tibia, third joint as long as the two basal; claws long sharp, less arcuate than on the other legs.

37. **Hagenius japonicus** (supposition).

Selys Monogr. Gomphi. p. 244; Cabot p. 10, No. 13, pl. iii, fig. 5.

One male nympha not full grown, dry, from Kanagawa, Japan, by Mr. Gulick. Length 28 mm.

Very similar to *H. brevistylus*, differs as follows: part between the antennæ less notched, inserted tubercle ovoid, third joint of antennæ less rounded, more angular externally; tubercles on occiput and hind legs blunt, very much less elevated; the sides of prothorax more blunt; abdomen straighter at sides and behind, more oblong, 9th segment shorter, its lateral angles not so sharp; dorsal hooks less developed, after 5th segment forming an elevated ridge; anal appendages shorter, sharper, superior not so deeply channeled at sides, before tip (which is not broken as presumed in Cabot's description) two very small polished tubercles; laterals one-third as long as inferiors; ridges on prosternum and mesosternum; its lateral spines and the hooks of coxa nearly wanting.

Though this species is very similar to *H. brevistylus*, the differences quoted seem to justify the separation. The doubt of De Selys (Odonates du Japon, 1883, p. 115) about the existence of *H. japonicus* in Japan, because he had not seen specimens in the collections from Japan except the type is apparently to be dismissed as the described nympha is surely from Japan.



38. **Hagenius? nanus** (supposition).

Selys Gomphin. Synops ii, Additions p. 37, No. 84, bis.

One young nymph in alcohol from Yeddo, Japan, by Prof. E. Morse. Length 15 mm.; breadth 7 mm.

Body flat, elongate, very hairy; head large, flat, broader than long, about oblong, between the antennæ a short, broad projection, nearly straight on tip; eyes small, round in the middle of sides; front angle before eyes conical; occiput large, straight behind, angles rounded, sides scarcely elevated; antennæ short, the two basal joints small, globular, third a little more than twice as long, flattened, bent up, a little dilated externally in middle, more than twice as long as broad: fourth short, black, conical; mask large, longer than broad, sides sloping to base, which has half the breadth of the front; middle third a short rounded lobe with a short comb of flat scales and four black short teeth on tip, palpus a flat broad lobe, rounded on tip, inside finely dentate; movable hook long, sharp, arcuate; prothorax smaller than head, transverse-oval, side angles rounded; wing cases reaching nearly apex of third segment; abdomen very little elevated above, half as long as broad, oblong, the 9th segment tapering suddenly; segments of equal length, 9th a little shorter in middle; 10th very short, inserted entirely in a broad deep rounded notch of 9th; lateral spines sharp on segments 7 to 9, the last one as long as segment 10; no dorsal hooks; venter flat, the two sutures as in *H. brevistylus*, the middle space a little smaller than the laterals; anal appendages short, twice as long as 10th segment, pyramidal strongly pointed, the laterals less than half as long as the inferiors; legs short, fit for burrowing; middle legs very little more distant than forelegs; the four anteriors with thick, strong, curvate, femora and tibiæ, the last ones with a strong external hook on tip; hind legs flat, reaching nearly 8th segment, third joint of tarsi as long as the two basal; legs very hairy, hairs very long.

This remarkable nymph is young, and some allowance will have to be made for this fact. Nevertheless I have compared it with nymphæ of *H. brevistylus* of the same size. The legs of *H. brevistylus* are running legs, tip of tibiæ without hook, middle legs equally more separated as the forelegs, than the hind legs compared with middle legs; the hind legs of the youngest nymphæ longer than the body. The abdomen of *H. nanus?* is more oblong; the third joint of antennæ less flat, elongate, the fourth conical; the mask has four black teeth; the head is somewhat similar, but the sculptures wanting or less finished; the nymph is very hairy. I do not know *H. nanus* described after one female; perhaps the nymph belongs to this species—if it is not a young nymph of *Chlorogomphus*.

39. **Uropetala Thoreyi?** (doubtful supposition).

Selys Monogr. Gomphin. p. 375.

Six nymphæ, young, in alcohol from Rocky Creek, near Gregson's Spring, Kentucky, Oct. 20, 1874, by Mr. F. G. Sanborn and F. W. Putnam. Length 15–20 mm.; breadth 5–6 mm.

Body elongate, moderately flat, very little hairy, except on legs, this extraordinary nympha combines head and antennæ of *Hagenius* with legs and abdomen of *Gomphus*; head flat, a little broader than long, between antennæ an oblong projection with a round notch on tip and sharp angles, inserted in which a cordate tubercle; eyes similar to *H. brevistylus*, more rounded, side part of head before front angles of eyes straight, not produced; ocelli visible; occiput similar, no tubercles. hind angles conical, not elevated; antennæ similar, but third joint broadest a little before middle, the apical half of the external margin more straight; mask similar to *H. nanus*? but the produced lobe less rounded, comb longer; the four teeth similar: palpus similar to *H. nanus*?, but instead of finely dentate, with six strong arcuate teeth, the last one on tip; prothorax as by *H. nanus*?; wing cases reaching 4th segment, with several black dots: abdomen a little elevated above, once longer than broad, a little narrower at base, enlarged to 6th segment, the following tapering; segments of equal length, 10th very short, about one-third of 9th, inserted nearly entirely in a deep rounded notch of 9th: lateral spines on 8th and 9th segments sharp, the last one a little shorter than segment 10: no dorsal hooks; lateral margin of last segments bent up a little, finely serrated: anal appendages of *H. nanus*?; venter slightly rounded, the two sutures as by *Hagenius*, a little less divergent on 9th segment: middle space a little larger than the lateral ones; legs short, fit for burrowing, very hairy; fore- and middle legs equally distant, femurs thick, bent; tibiæ with a strong external apical hook; hind legs wider separated, short, scarcely reaching 6th segment, flat, tibiæ shorter than femur, tarsus as long as tibia, third joint as long as two basal, claws long, sharp, bent at tip; abdomen above with ill defined brown markings; each side of the median line three black basal dots on most segments.

This remarkable nympha has the head and antennæ of *Hagenius*, the ventral sutures and mask, except palpus, of the supposed *Hagenius nanus*, the distance of middle legs, the abdomen, except last segment of *Gomphus*. The species to which the nymphæ, which are collected in winter, and therefore young (perhaps very young), belong is not known. It is, of course, possible that the imago is not yet known, but this is somewhat improbable, as just in this part of Kentucky many excellent collectors have been collecting. Perhaps it may be the nympha of *Uropetala Thoreyi*, which is there by no means rare. At least I know no other species to which it can be supposed to belong.

### III LEGIO LINDENIA.

Genus ICTINUS (supposition).

Selys Monogr. Gomphin. p. 263.

The nymphæ of *Ictinus* though similar to *Hagenius* by the large rounded abdomen and hind legs longer than the abdomen, differ by important characters from *Hagenius* and all other groups.

The hind legs have only two jointed tarsi, whereas all other Gomphina have three joints. The longitudinal ventral sutures are straight, but divergent on the 2d and 9th segments as in *Hagenius*. Besides

these longitudinal sutures there are in all Gomphina transversal ones indicating the end of the segments. Now *Ictinus* has an oblique additional suture on each side of segments 7 and 8 in the lateral space of the venter. This suture begins on the lateral edge on the base of the lateral spine (a little before the end of the segment) and runs to the middle of the lateral space of the foregoing segment, forming a triangular additional part. It would be easy to accept this additional part as the indication of the large lateral leaf on the imago, but this leaf occurs only on the 8th segment, besides that the additional suture is wanting in other Gomphina with lateral leaves. On segments 3 to 6 the additional triangular part is inflated with an impressed rim below, ending just where the ventral bags are situated, but here no suture is visible, and the ventral bags are (in one specimen) visible only on 4 to 6; similar impressions are on the sides of abdomen of *Aphylla*. The head is large, and has between the antennæ a flat projection as *Hagenius*; the under side of head is projected below the eyes, so as to be seen from above, and similarly projected near the mouth parts; the occiput is large and separated from the front by a suture; antennæ with third joint thinner than second, cylindrical, a little flattened above; mask large, sparse, middle third more or less produced with teeth and comb; palpus short, broad, hooked, inside with teeth; movable hook not very long; prothorax saddle shaped, stigmata not covered; abdomen strongly roof shaped, with a crest of dorsal hooks and sharp lateral spines; apical margin of segments 7 to 8 notched; last segment inserted in 9th; hind legs longer than body, front legs fit for burrowing; base of legs successively wider distant; prothorax stigma free.

After all, *Ictinus* forms a group well characterized and different from all others.

40. ***Ictinus præcox*** (supposition).

Cabot p. 11, pl. 1, fig. 4.

Five nymphæ, not entirely full grown and younger ones, all females from the Sutledge River, middle Himalaya, and one from East Jumna out of holy tank, near Delhi, in alcohol, by Rev. M. M. Carleton. Length 21 to 16 mm.; breadth 12 to 8 mm.

Body short, stout, roof shaped, similar to *Hagenius*, about circular; head large, cordate, divided by a straight transversal suture behind the eyes, which are moderately large, triangular, rather prominent; between the antennæ a small square projection, with rectangular notch on tip and sharp angles, inserted in which is a short transversal tubercle; ocelli visible: occiput behind the transversal suture about as long as the front part, hind border nearly straight, angles blunt, well rounded; head beneath at each side with a small prominent tubercle below the

eyes and projecting a little more than the eyes, so that the tip is visible from above; antennæ shorter than head, joint one globular, two smaller, annular, three very hairy twice as long as the two basal, cylindrical, straight, not thicker than second, but a little increasing to tip, which is bent up a little and blunt: fourth very short, conical; mask extending between forelegs, large, flat, square, basal fourth a little narrowed, sides bent up; middle third of fore border produced in a rounded short lobe, with a short comb of scales, and on each side with seven short, dark teeth: palpus just meeting, arcuate, moderately sharp pointed, inside with about a dozen dark teeth similar to those of the mask; movable hooks not very long, sharp, arcuated: prothorax a little narrower than head, transverse oval, half as long as broad, side angles rounded: wing cases reaching 4th segment: abdomen large, nearly circular, more than twice broader than head, broadest at 7th segment, somewhat rounded below, strongly roof shaped above; segments 1 to 5 short, 6 to 9 longer, 7th and 8th about twice as long as the basal ones, 10th very short, inserted entirely in a large obcordate excision of 9th: the lateral edges of segments 2 to 9 as in *Hagenius*, separated by the ventral suture, forming lateral spines on segments 4 to 9 successively larger, triangular, sharp, longest on 7th; the lateral edges with long hairs, but on 7 to 9 with a comb of strong, arcuate, sharp spines; lateral border of 9th very oblique, the spines longer than last segment: dorsal hooks on 2 to 9, the basal ones smaller and separated, 6th to 9th on the whole length of segment forming a sharp dorsal crest: anal appendages short, stout, triangular, hairy, a little longer than last segment, laterals one-third shorter than the others, very sharp, more than the others; scars large, four round polished spots on each side of the middle line; dorsum roughly granulated; ventral sutures only a little divergent on 8th, more divergent on 2d segment; middle space about half as broad as the laterals: ventral bags small on 4 to 6?; segments 7 and 8 with a kind of additional ventral suture, beginning short before the lateral spine and going oblique to the foregoing segment, not reaching the longitudinal ventral sutures: legs long, hairy, not very strong; forelegs less distant than middle legs, hind legs widely separated; the four anterior legs equal, femur stronger, bent; tibia straight, with an apical exterior hook, tarsi short: hind legs longer than abdomen, femur straight, reaching 7th segment, tibia shorter: tarsus one-third shorter, only two jointed (as on the anterior legs), basal joint very short, claws long, bent on tip; the apical margin of the 8th ventral segment between the longitudinal sutures is slightly bisinuated, and just in the middle are two very small but sharply divided tubercles, which represent always the female genitals. I have not seen any male.

That the nymphæ belong to *Ictinus* is sure, as in East India no other genus of the group exists; perhaps it may belong to *I. præcox*. There is in the collection a dry specimen from the collection of the late Dr. W. Schneider, in Breslau, Prussia, said to be from Brazil. The specimen is 23 mm. long; wing cases reaching half of 7th segment; it is a male, and the only one seen. The specimen is alike to the Himalaya ones, and the figures by Cabot except 4*d* and 4*e* are from this specimen. I should believe it to be more prudent to accept the locality Brazil as doubtful, till more specimens arrive. There exists a species of *Ictinus* (*I. latro* Er.) in British Guyana, collected by Sir R. Schomburgk, in the Museum of



